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DEPARTMENT OF EDUCATION

EDMONTON, ALBERTA

PROGRAM OF STUDIES FOR THE HIGH SCHOOL

"a" AND "b" PROGRAMS IN:

WOODWORK
ELECTRICITY
AUTOMOTIVES
METALS

This outline is authorized by the Department of Education.

September 1949

CURRICULUM
EDUCATION LIBRARY

"a" and "b" Programs in Woodwork, Electricity, Automotives, Metals.

These four-credit programs are designed to meet a specific need which has arisen in a few centres in the province.

Permission to offer these programs is given only when the following conditions exist:

1. A definite need for such a program is apparent;
2. suitable accommodation and adequate equipment are available;
3. the instructor's qualifications are such as to ensure the successful presentation of a program of this type.

These programs aim to make provision for students who are unable to take advantage of eight-credit programs, yet who have interests in technical courses. They are also intended to meet the needs of those students who desire to round out their academic education with experiences that will tend to broaden their horizon, to acquaint them, to some extent with the developments in science and industry and to provide a background for profitable use of their leisure time.

In order that the student may receive the optimum benefit from these programs it is essential that vocationally sound practices be used and that every endeavour be made to encourage conformity to such practices. Higher standards of achievement and attainment than those reached at the Intermediate School level should therefore be insisted upon.

Time Allocation

The time allocation is one-half day per week or its equivalent.

Drafting

Drafting is an integral part of each program and specific periods should be set aside for this phase of the program.

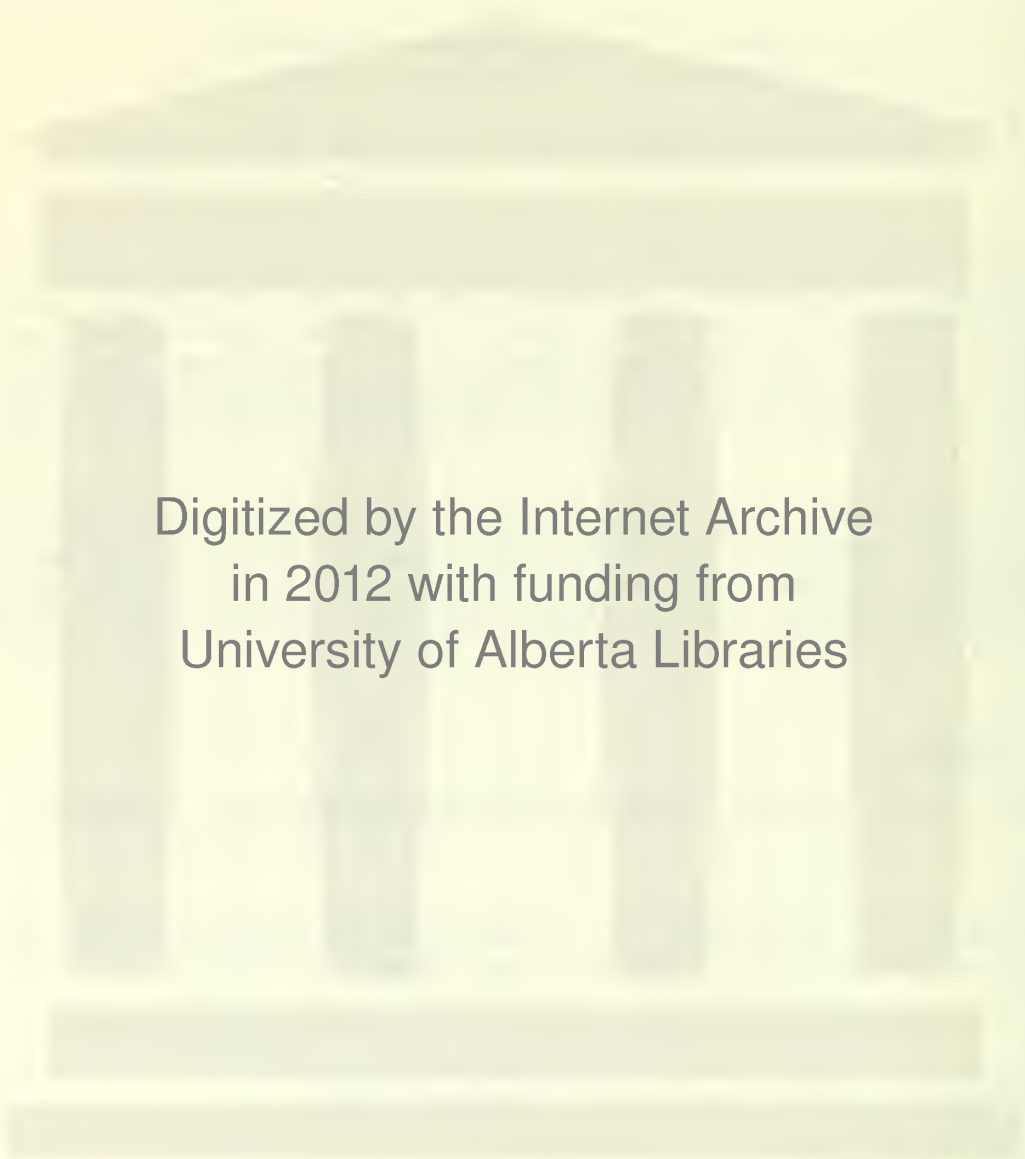
Records

Instructors should keep the following records:

1. Attendance
2. Topics discussed
3. Tests administered
4. Student grading
5. Student achievement.

A simple file card system is recommended for these records.

Students should keep a brief record of the following:



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1. Topics discussed
2. Project work showing bills of materials and costs
3. Demonstrations observed
4. Comments on field visits

SAFETY EDUCATION

There is a heavy annual loss of life through accidents. They also cause disabilities and may result in suffering and a heavy loss of earning power.

The responsibility of shop instructors with reference to "safety" should not be confined to shop activities alone; they should be concerned with the establishment of "safety habits" in all areas of the community. Safety factors relevant to the shop, school, farm, home and the community should receive definite attention at frequent intervals.

It is imperative that scientific safety guidance should be provided for students in shop classes.

This may be done through arousing and fostering interest in safety practices. If students learn to work safely by adopting and practising the correct technique of using tools and machines, a considerable saving in human life and suffering will be the ultimate result.

Safety rules should be posted in a conspicuous place in the shop and frequent reference made to them. Safety posters have a definite value and should be prominently displayed.

Insistence upon students practising safety habits when working with tools and equipment should not be spasmodic, but a continuing process.

"THE BEST WAY TO PREVENT ACCIDENTS IS TO PREVENT CIRCUMSTANCES ARISING THAT WOULD TEND TO INVITE THEM."

"A CAREFUL MAN IS THE BEST SAFETY DEVICE KNOWN."

The following pamphlets, obtainable from the Workmen's Compensation Board, Edmonton, are recommended for reference:

1. Firt Aid Service
2. Digging, Drilling, Cleaning or Repairing of Water Wells
3. Storage, Handling and Firing of Explosives.
4. Trench Construction or Repairs.
5. The Control of Dust.
6. Drilling, Cleaning, Repairing, Operation and Maintenance of Oil and Gas Well Drilling Plants, Rigs and Equipment.
7. Laundry and Dry Cleaning Machinery.
8. Regulations applying to Grain Elevators.
9. Regulations Governing the Installation and

Operation of Power Transmission Machinery, and Equipment.
10. Logging, Saw-Mill and Woodworking, Digging, Drilling, Cleaning or Repairing of Water Wells.
11. Accident Prevention Committee.
12. Building and Excavations.
13. Bulletin No. 359, Section of The Workmen's Compensation Act dealing with Accident Prevention.

WOODWORK 1a

Drafting

1. Reading working drawings and blueprints.

2. Correct use of drafting equipment.

   A. Correct positioning and attachment of paper to the drawing board.
   B. Use of equipment - T-square, set square, scales, compasses, etc.
   C. Upper and lower case letters, figures and fractions.
   D. Lines, symbols and legends used in drafting.

3. Geometrical constructions:

Utilizing problems likely to be found useful in the practical application of drafting fundamentals.

4. Working drawings:

Orthographic drawing, two-view and three-view drawings.

   A. Orthographic projection - fundamentals.
   B. Rules of dimensioning.
   C. Scale drawing in orthographic projection.

5. Finished drawings of each shop project constructed should be made.

Related Theory

1. Wood as a material.
2. Woodworking tools.
3. Tool operations.
4. Tool sharpening.
5. Wood finishing.
6. Spindle and face plate turning.
7. Simple wood working machines.

The topics may be divided into sections as follows:

(a) Tools:
1. Tool sharpening - saws, plane irons and chisels, gauges and bits,

gauges and scrapers.
2. Cutting tools - construction, use and care of saws, planes, chisels, bits and other edged tools.
3. Laying out and testing tools - squares, gauges, rules, bevels, dividers, calipers, etc.

(b) Operations:

These are necessarily linked with the consideration of tools used but short formal lessons following a demonstration could include brief notes and sketch work illustrating the operations.

1. Getting out stock - use of various tools employed.
2. Squaring stock - order of procedure,
3. Chamfering and mouldering edges - straight and stopped.
4. Chiselling - horizontal, vertical and diagonal paring.
5. Boring.
6. Mortising - methods used.
7. Dowelling - marking and boring.
8. Routing - methods used and tools.
9. Tool finishing a surface - smooth plane and sand papering.

(c) Materials

1. Wood - tree growth; classification; common kinds; lumbering; storage and seasoning; defects.
2. Finishing materials - paint and oils; sealers and filler; shellac; varnish; waxes and polishes; abraisives; glues and sandpaper.
3. Hardware - nails; scres; hinges; catches; fasteners.

(d) Project Work

Suggested list of projects: Ironing board, book shelf, kitchen step-ladder, jardiniere stand, costumier bookcase, medicine cabinet, kitchen stool, small table.

A simple project in wood turning should be completed.

Reference Books

"General Drafting", Fryklund and Kepler
"Modern Drafting", Johnson and Newkirk
"Principles of Woodworking", Hjorth
"Instructional Units in Woodworking", Brown and Tustison
"The Art of Woodturning", Klenke
"The Carpenter's Square and Its Use", (pamphlet) Romig, State Building Congress, Portland, Oregon.

WOODWORK 1b

Related Theory

A. A fairly detailed study of the precautions to be taken in using such machines as the circular saw, bandsaw, jointer, surface mortiser and shaper.

B. Special woodworking tools such as scrapers and universal planes.

C. Cabinet making - principles of good construction, design and craftsmanship.

Materials

1. Lumber - sawing, slash and quarter cutting, air and kiln seasoning, plywoods, veneers.
2. Hardware - hinges, hasps, locks, drawer pulls, etc.

Finishing

Review of such methods as oiling, staining, scaling, filling, shellac and varnish finishes, rubbing down and polishing.

Shop Work

The first few weeks of the fall term could be devoted to a careful review of the more important tool operations and tool sharpening. This period of work may be used to make needed equipment such as mallets, bench hooks, drawing boards, etc. Basic operations should be systematically reviewed and a high standard of work and accuracy encouraged.

Project Work

Each student should carry out one project in cabinet work. Such a project might be a coffee table, tea wagon, writing desk. desk, cedar chest, or a project of a similar nature. The more advanced turning operations should be demonstrated. Emphasis should be on good planning, good design, proper work procedure and craftsmanship.

References

Same as for Woodwork 1a.

ELECTRICITY Ia

Drafting

1. Reading working drawings and blueprints.

2. Correct use of drafting equipment:

   A. Correct positioning and attachment of paper to the drawing board.
   B. Use of equipment - T-square, set-square, scales, compasses, etc.
   C. Upper and lower case letters, figures and fractions. Balancing of title and other lettering.
   D. Lines, symbols and legends used in drafting.

3. Geometrical Construction:

   Utilizing problems likely to be found useful in the practical application of drafting fundamentals.

4. Working Drawings:

   Orthographic Drawing:
   Two-view and three-view drawing.
   1. Orthographic projection - fundamentals
   2. Rules of dimensioning
   3. Scale drawing in orthographic projection
   4. Identifying and indicating views.

5. Finished drawings of projects such as bell transformer, electromagnet winding-form, bicycle generator machine-parts.

Electricity Ia

Related Information

Symbols and their uses.
Static and current electricity. Magnetism and the electron theory. Conductors and insulators. Circuits.

Magnetism:

Nature of magnetism.
Classes of magnets - natural, permanent, and electromagnets.
Law of attraction and repulsion.
The compass; declination and inclination.
Earth's magnetism. Magnetic spectra or figures.
Lines of force. Magnetic induction.
Molecular theory of magnetism. Method of magnetizing steel.
Magnetic fields and circuits. Permeability.

Currents of Electricity:

Electrical units: volts, ampere, ohm.
Positive and negative directions of flow.
Kinds of currents: direct, alternating, pulsating, continuous.

Resistance: Conductance.
Ohm's Law. Drop of potential.

Electro-Magnetism:

Study of magnetic fields about straight conductors, single loop, helix, solenoid and electromagnet.
Factors governing strength of electromagnets.
Flux, flux density, ampere-turns.
Review permeability. Applications.

Circuits and House Wiring:

Systems used - Series and parallel circuits.
Legal requirements. Wiring testing.
Wires and carrying capacities. Use of wire gauge, mil-foot, circular mills.
Kinds of insulation.
Protection of circuits: fuses and circuit breakers, testing fuses, testing for short circuits.

Radio Construction and Operation

Shop Practice

General safety precautions, First Aid Facilities Cabinet. The care and maintenance of apparatus, equipment and tools.

1. Electrical-splicing: Making connections with solid and stranded insulated conductors. (Western Union, tee, fixture.) (bound types). Methods of tinning; soldering, sweating, dipping.
Insulating and taping.

2 Connecting cells or batteries in series or multiple, (parallel). Measuring electro-motive-force of the groups (no load).
Connecting constant loads, measuring line voltage and amperage.
Calculating electrical resistances of series and parallel circuits.
Application of Ohm's law to portions and parallel sections of series or multiple circuits.

3. Diagraming bell and buzzer circuits used in homes, hospitals and hotels, offices, using a direct current supply or a bell transformer.
Types of circuits; simple, parallel, loop, single-stroke, series-single-stroke-vibrating, two-door chimes.
Return call type circuits; single-wire, two-wire, three-wire, four-wire.
Annunciator systems; simple and return-call.
Interphone signal system, bell circuit wiring only.
Day or night janitor call circuits.
Adjusting and repairing signal devices.

4. Direct current line or battery polarity tests; Electrolytic, (water) potato, voltmeter, magnetic needle, polarity indicator.

5. Designing and making a fuse tester.
   Locating blown fuses, short-circuits, grounds or open-circuits in lighting circuits.

6. Assembling, connecting and testing a single lamp fluorescent fixture.

7. Testing and repairing appliance cords, lamp extensions, toasters, room heaters, cookers, flat-irons, curlers.

8. School maintenance jobs. Repairs to school installations.

Projects

One or more of the following suggested projects might be made:

A. Step down transformer
B. Electric door latch
C. Electric door chimes
D. Radio set.

Text Book

"Elementary Electricity and Magnitism"; Jackson and Black.

Reference Books

"Essentials of applied Electricity" Jones
"Elements of Electricity"; Tembie
"Applied Electricity for Practical Men"; Rowland
"Audel's New Electric Library"; Audel

ELECTRICITY Ib

Drafting

Introductory resume and review:

Lettering, drafting lines, scaling, planning and dimensioning.

Pictorial method of representation by isometric projection. Limitations: Project drawings involving isometric and non-isometric straight lines.

Explanatory definitions of the terms: Pictorial method, isometric projection, isometric and non-isometric lines, obligue angles, perspective view.

Comparison of methods; orthographic and isometric projections.
Planning and locating center lines.

Suggestions:
A. Simple try-out plates, involving straight isometric lines only. (square, and rectangular models, projects)
B. Isometric and non-isometric straight lines only. (brick, hexagon-blank, shelf)
C. Conversion of orthographic views (drawings) to isometric projection.

Pictorial method of representation by cabinet projection.

Limitations: Drawings are restricted to straight lines and plain circles.

Explanation of the terms: Cabinet drawing, fore-shortened, receding lines.

Comparison of methods employed: Cabinet and isometric projections. The utility: Orthographic, isometric, cabinet and perspective, to mechanics, industry and the public.

Development of simple surfaces.
Pattern or stretchout drawings of prisms, cylinders, pyramids and cones.
Applications suggested: Funnels, two-piece 90 degree stove-pipe elbow, measuring or pouring devices.

Electrical drawings:
Suggestions: Meter-loop 2 or 3 wire, ammeter and voltmeter external connections. Simple radio connections and symbols.

Electricity Ib

Related Information

Introductory remarks: A brief resume of the subject content in course, Electricity Ia.

1. Electromagnetism:

The movement of electrons in conductors and the relative magnetic spectra manifestations.

Discovery: Plotting the orbits of magnetic whirls surrounding a straight conductor with iron filings. Ascertaining the direction of magnetic flow with the aid of a magnetic needle. The use of the right-hand thumb rule.

A study of opposing or converging fields surrounding conductors placed parallel to one another.

Illustrate the cumulative field effect of coil turns in the helix or multi-layer solenoid coils.

Factors that determine the magnetic-field strength of coils (helix, solenoid, electromagnet) (ampere-turns and permeability)

Experiment: Weight the keeper of an electromagnet to approximate increased magnetic strength and find the saturation-point of magnetisation.

Application: Uses of magnetic coils in devices. (generatiors, motors, lifting-magnets, door-locks, meters)

2. Electromagnetic-induction:

The detection of polarities and measurements of induced voltages and current flows in a single straight conductor. (galvanometer)

Methods of induction:
A. A moving conductor in a permanent magnetic field.
B. A stationary conductor and a varying D.C. magnetic field.
C. X-Rotating conductors in a bipole field.

Review: Conversions of current flows into lines of force and magnetic flux in current flows.

Measuring deflections of induced voltages in mult-turn coils for ratio-comparative values of voltage and turns.

Experiment: Demonstrate that the factor-values, number of conductors flux-density and the time element, govern the value of the electro-motive-force produced.

Apply Fleming's right-hand rule for induced currents. (The use of hand rules for electron flows may cause confusion at this time).

Demonstrate Lenz's law: The attraction and repulsion between primary and secondary currents. (induced currents)

Application: Simple direct current generator. (Electromagnetic induction).

Define the terms, mutual-induction and self-induction.

Application: High tension coils and self-induction ignition coils.

3. House electrification: Legal requirements, National Electrical Code, Provincial and Civic Government Boards.

Suggestion: Make a study of wiring installation and fixtures of an average home. (supply lines, meter-block, outlets, wattage loads, heating, lighting, motor circuits, fusing, over-load devices, appliances.)

Two and three wire services, wire sized, carrying capacities.

Factors of resistance, cross-sectional area, length, temperature, nil-foot constant.

4. Elementary Radio:

Alternating current curve, alternation, cycle, wave-length, frequency, velocity (radio-wave).

Suggestions: A study of simple tricode type receiving set. (antenna, reception, amplification, coils, resistors and condensers).

The use of battery and power supplies.

Shop Practice

1. Special circuits:

Three heat range switches, (4 and 5 points types)

Motor reversing switch connections, (series and shunt type small size motors), emergency master light switch control, stage-dimmer control, three-way switch connections with lines extended, thermal cutout devices.

2. House Wiring:

Draw a floor plan and indicate meter block, outlets, (light, wall bracket, switches) specials, (heating, motor).

Compute wattage load, number of circuits, 2 or 3 wire service.

Represent circuits in working plan.

(Modern methods of installations are preferable. A small amount of conduit types, (rigid, flexible, moulding) may be made to serve a useful purpose, in the building.

Suggestion: Connect up some receptacles, switches, (single pole, three-ways and four-ways) electroliers, (2 and 3 circuit types) on the work bench before installing wiring and fixtures in a practice frame house.
(Underwriters' knot, cords, pendants, plug-caps, sockets).

3. Designing and winding a magnet-charger (adjustable type).
Magnetizing permanent magnets for magnetos, bicycle generators and measuring instruments.

4. Designing a simple form of direct-current type motor to run off a batter supply circuit. (Uses: boats or mechanical toys).

5. Suggestions: Students may wish to make a signal device or other project that includes an electromagnetic construction in part; chimes, circuit breaker, shell-type lifting magnet, galvanometer).

6. Connecting and testing triode for plate-current and gridaction.

7. Introducing the elctric-eye in a simple circuit.

8. Designing and constructing a test-lamp and prods.

9. Printing or mapping magnetic-fields; (ozalid or blue-print, waxed).

10. Radio assembly work and circuits.
(Suggestion: Students to be encouraged to purchase sets or parts for a simple one or two tube set to promote individual interest).

(Students having special abilities may be permitted to do other projects in which raditrons are used.) (Code-oscillator, hearing-aid).

11. General electrical repairs within the scope of the student's ability and experience.

Textbook

"Elementary Electricity and Magnetism"; Jackson and Black

Reference Books

"Essentials of Applied Electricity"; Jones
"Elements of Electricity"; Tembie
"Applied Electricity for Practical Men"; Rowland (McGraw-Hill)
"Audels New Electric Library"; Audel,

METALS Ia

Machine Shop Practice Ia

Note: Only one phase of the Metals program may be taken in any one year.

Drafting

Same as for Electricity Ia: in No. 5 change to:
Finished drawings of machine parts and projects constructed.

Related Information

1. Elementary metallurgy pertaining to iron and steel.
2. Temperature indications and their effects on metals.
3. Study of machines used.
4. Operations used.

Shop Practice

The work in this section might well be confined to the drill press, power grinder and lathe.

Lathe work could be confined to the following:

1. plain parallel and taper turning
2. centering with combination centering drill
3. turning work in the chuck or between the centers
4. knurling
5. cutting "V" screw threads.

Names and purposes of various parts of the lathe. Shapes of tool bits, rakes and clearances, also tool bit holders, cutting speeds for tool bits, position of tool bits for various kinds of work. Types of drills and drilling speeds, defects in drill sharpening, standard screws and tapping drill sizes. Principles and use of the micrometer gauge.

Projects

Suggested: plumb bob, bench stop, machine bolt and nut, small pulley, etc.

METALS Ib

Machine Shop Practice Ia

Drafting

1. Review: - Lettering, drafting lines, scaling, planning and dimensioning.
2. Orthographic Projection (review)
3. Isometric Projection
   (a) Explanation of the term
   (b) Isometric and non-isometric lines
   (c) Oblique angles

4. Comparison of Orthographic and Isometric projections.

5. Cabinet Projection

(a) Explanation of the term
(b) Foreshortened and receding lines.

6. Comparison of Isometric and Cabinet projections.

7. Finished drawings of machine parts and projects constructed.

Related Information

Further study and enlargement of topics suggested in the Ia program.
Operation of a more difficult nature.

Shop Practice

Review of procedures in the Ia program.
Taper and thread cutting.
Introduction of new procedures as required in project construction.

Projects

Projects of a more difficult nature than those in the Ia program should be selected.

References:

"Machine Shop Practice"; Jones
"Elementary Machine Shop Practice"; Canadian Machinery and Manufacturing News, Toronto.

METALS Ia

Note: Only one phase of the Metals program may be taken in any one year.

Bench Metal Work Ia

Drafting same as in Forging Ia

Related Information

Common metals and their alloys.
Temperature indications and their effects on metals.
Elementary metallurgy pertaining to iron and steel.
Study of tools such as hacksaw, file, chisel, stocks, dies and taps, standard screw threads, tapping drills and drilling speeds.
Soldering.

Shop Practice

Operations involved in constructing projects such as filing, fitting, riveting chipping, shear cutting, marking and laying out surfaces.

Projects

Suggested list: try square, sliding bevel, calipers, compass or dividers, tap wrench, hinges, pipe straps, shelf brackets, etc.

METALS Ib

Bench Metal Work Ib

Drafting

Review Orthographic Projection; rest of drafting same as in Drafting Ib for Machine Shop Practice.

Related Information

Further study of topics suggested in Bench Metal Work Ia.
Study of other topics associated with the operations involved in project construction.

Shop Practice

Operations involved in procedures used in project construction.

Projects

Projects may be selected from the list suggested in Bench Metal Work Ia or other projects which meet student needs.

References:

"Units In Bench Metal Work"; Smith, Capp, Clark Co.

METALS Ia

Note: Only one phase of the Metals program may be taken in any one year.

Forging Ia

Drafting - same as in Electricity Ia except No. 5 to read: Finished drawings of projects constructed.

Related Information

The Forge:

(a) Its operation and maintenance
(b) Preparing coke from coal
(c) Tools and their classification
(d) Heat treatment of metals - annealing, hardening and tempering
(e) Forging principles.

Shop Practice

Operations and correct procedures involved in drawing out, bending, twisting, upsetting, welding.

Projects

Suggested list of projects: gate hook, cold chisel, hay hook, door stop, clevis and pin, scriber, meat hook.

METALS Ib

Forging Ib

Drafting

Review Orthographic Projection
Isometric Projection
Same as in Drafting for Machine Shop Practice Ib

Related Information

Further study of topics suggested in Forging Ia
Useful properties of lead, copper and tin; extraction and use.
Identification and working properties of ferrous metals.

Shop Practice

Fullering, swageing, punching, splitting and welding, hardening and tempering.

Projects

Projects may be selected that meet the needs of the student.

References:

"Units In Forging and Welding"; Smith, Capp Clark Co.

Note: Only one phase of the Metals program may be taken in any one year.

Sheet Metal Ia

Drafting

1. Reading working drawings and blueprints.

2. Correct use of drafting equipment:
   A. Correct positioning and attachment of paper to the drawing board.

   B. Use of equipment - T-square, set-square, scales, compasses, etc.

   C. Upper and lower case letters, figures and fractions.
   Balancing of title and other lettering.

   D. Lines, symbols and legends used in drafting.

3. Geometric Constructions:
   A. Development of the surface of the square and rectangle.

   B. Development of the surface of the cylinder.

   C. Development of the surface of the cone.

4. Working Drawings:

   Orthographic Drawing:
   Two-view and three-view drawing.
   A. Orthographic projection - fundamentals

   B. Rules of dimensioning

   C. Scale drawing in orthographic projection

   D. Identifying and indication views.

5. Finished drawings of projects to be made.

Related Information

1. Elementary metallurgy relating to the extraction of iron, copper, aluminum and nickel from their ores.

2. Properties and uses of metals used.

3. Tools used in sheet metal work.

4. Operations used in sheet metal work.

5. Theory of soldering - effects and methods of counteracting oxidation.

6. Allowances and related calculations for hems, seams, and slip joints.

Projects

Projects should cover the more common operations of a sheet metal shop, such as rivetted or soldered lap seams, folded or grooved seams and double folded seams, notching, forming, rolling, braking, grooving, burring, turning and wiring edges, beading and crimping, soldering with coppers and sweat soldering.

Suggested projects for this class of work: - Cooky cutters or small round pans with lap seams and folded edges, measuring cups with cylindrical or flaring sides, with wired edges and grooved seams, grovers' scoops, conical projects such as a funnel, draft hood or ventilator head, rectangular pans with vertical of flaring sides, boxes with hinged lids. Methods of fastening corners of boxes between the sides and ends.

METALS Ib

Note: Only one phase of the Metals program may be taken in any one year.

Drafting

Same as in Ia but add (d) and (e) to No. 2 as follows:

(d) Oblique cutting planes
(e) Elbow sections and intersections.

Sheet Metal Ib

Related Information

Metallurgy, including:

1. Further study zinc, tin, lead.

2. Use in sheet metal work.

3. Operations of a more difficult nature.

4. Procedures used in more advanced projects.

Projects

Projects such as more advanced box forms, elbows, hoppers, chimney stacks, vases, lawn ornaments, etc.

References:

"The Essentials of Sheet Metal Working"; Dougherty.
"Sheet Metal Worker's Manual"; Broemal.

AUTOMOTIVES 1a

Drafting

1. Reading working drawings and blueprints.

2. Correct use of drafting equipment:

   A. Correct positioning and attachment of paper to the drawing board.

   B. Use of equipment - T-square, set square, scales, compasses, etc.

   C. Upper and lower case letters, figures and fractions.

   D. Lines, symbols and legends used in drafting.

3. Working drawings:

   Orthographic drawing, two-view and three-view drawings.

   A. Orthographic projection - fundamentals.

   B. Rules of dimensioning.

   C. Scale drawing in orthographic projection.

4. Finishing drawings of parts of automobiles, chassis and engine. (These should be associated with the parts studied.)

The intention of the course set out in the following outline for Automotives 1a is to furnish the present or the future automobile owner or operator with a working knowledge of the care and maintenance of an automobile, the general principles on which it works and the correct handling of the automobile on the road. This course is designed for the education of the well-trained operator rather than that of the practical repairman. Thus the course is comprised mainly of minor repairs and servicing procedures; a practical study of the automobile as a whole; a study of the chassis and its separate units with emphasis on their interrelationships; and the mode of operation (but not actual driving instruction). Minor repair work and servicing procedures possible with the limited facilities and tools available should be encouraged. It is assumed that a shop capable of housing at least one car or more is available in the school.

N.B. Safe driving practices and traffic rules should receive due attention.

THE AUTOMOBILE

Theory: The general characteristics of the modern gasoline automobile. Study of body types. The Chassis - definition and function.
Characteristics - wheel base, tread, road clearance, turning radius.
Divisions of the chassis and their functions - power plant, transmission system, running gear, steering system, brakes and electrical system.

Shop Applications: Recognition of cars of various manufacturers. Identification of body types. Measurement of wheel base, tread, road clearance, etc. Adjustment of service and hand brakes. Bleeding of hydraulic brake systems. Recognition and examination of chassis divisions and units. Study of chassis lubrication requirements and specifications. Actual lubrication of chassis.

Theory: Fundamental features of construction and operation of the multicylinder, gasoline, automobile engine. Essential parts and elementary operation of the four-stroke cycle engine.

Types of engines - in line, V, L-head, I-head. Valve timing. Valve clearance.

Auxiliary engine systems - cooling, lubricating, fuel and carburetion, exhaust, ignition covering general principles and features only.

Shop Application: Recognition of units and parts of an engine (in or out of a car). Knowledge of correct technical names. Identification of units and parts in the auxiliary systems. Minor servicing jobs - valve clearance adjustment, cleaning spark plugs, adjusting breaker points, servicing air cleaners, installing or adjusting new fan belts, cleaning engine, changing engine oil, checking oil level, making of gaskets where feasible.

Service, or adjustment jobs which require only limited dismantling of the engine, or other units may be attempted. Tools and equipment available are a limiting factor in this regard.

THE TRANSMISSION SYSTEM

This section of the course is interpreted as covering not only the gear box, but all of those units whose function it is to transfer power from the engine to the rear wheels.

Theory: General principles of units involved in the passage of power from engine flywheel to the rear wheels - clutch, gearbox, drive shaft and torque tube, universal joints, differential and rear axle assemble. This should be a very general and limited survey only.

Shop Applications: Study of clutch location and operating principles on the car (externally). Proper adjustment and clearance of the clutch pedal.

Draining, flushing and filling of gear box with correct lubricant. Study of sectionalized, or practice gear box. Computation of gear ratios - experimentally and mathematically.

Draining, flushing and filling of differential with correct lubricant. Removal and replacement of inspection plate. Cutting new gasket for plate. Gear ratios and overall gear ratios of gear box and rear end combined. Identification of helical and hypoid rear axles - proper lubricant for each type.

Installation of wheel grease retainers. Proper removal of rear wheels from axle shafts.

Correct inflation pressures and repair of simple flat tires.

THE RUNNING GEAR

Theory: The front axle - purpose and construction. Basic details and requirements of steering geometry - camber, tow-in, caster, etc.
Relation of steering gear. Types of steering gears.

Shop Applications: Study of the parts and general assembly of a front axle. Toe-in adjustment at the tie rod. Lubrication and adjustment of front wheel bearings. Adjustment and lubrication of steering gear.

BENCH WORK

Some thread-cutting and soldering experience should be provided. The making of a stud and nut is an excellent and interesting way of getting across instruction in the use of dies and taps and associated information on the various kinds of threads and their purpose. This project also provides scope for measuring, hacksawing, filing, marking and punching, drilling and finishing.

A soldering project associated with the automobile is also another essential piece of bench work. Splicing two pieces of tubing together by various means is one example.

Text-book recommended: "Automobile Construction and Operation"; Easton and Mahn.

References:

"Automotive Essentials"; Ray Kuns
"Automotive Mechanics"; Barger
"General Drafting"; Fryklund and Kepler
"Modern Drafting"; Johnson and Newkirk.

AUTOMOTIVES 1b

(Automotive Electricity)

Drafting

A. Fundamentals, specifications and applications of Isometric Projection.

B. Isometric drawings of selected projects associated with the program.

AUTOMOTIVES 1b

(Automotive Electricity)

Automotives 1b will seek to provide students with opportunity for a theoretical, and practical study of the essentials of the electrical system of the automobile.

The theory section will aim at giving a general knowledge of the fundamentals of electricity as applied to the automotive electrical system; the practical shop portion will apply these fundamentals to the actual units.

Theory

The simple electrical circuit. Meaning of voltage, current and resistance. Electrical units of measurement - volt, ampere, ohm and watt. Ohm's Law, I equals $\frac{E}{R}$ with simple applications. Series, parallel and series-parallel circuits.

Magnetism. Association with an electrical current. Magnetic induction, with applications to ignition coil, relays, etc. Applications of electromagnetism to electrical circuits and units of the automobile - lighting circuits, horn, ignition system, generator and starting motor.

The automobile storage battery. Construction and operation.

Shop Applications

Ignition - Primary and secondary circuits. Units involved and operating principles. Bread board wiring of typical circuits using actual units. Simple tests for "grounds", "shorts" and "opens" as applicable. Firing orders and principles of ignition timing.

Cleaning and gapping of spark plugs. Proper selection. Cleaning and setting of breaker points.

Magnetos. Servicing, testing and timing.

Generators and Starting Motors - Dismantling and assembly. General testing of armature, field windlings and brush holders for faults. Cleaning commutator. Undercutting mica. Seating brushes. Generator cut-out - testing, setting and installation.

(Voltage and current regulators should be considered as beyond the scope of this course. Any shop work thereon should consist of replacement of defective units only.)

Lighting, and Horn Circuits - Bread board duplication of typical circuits - headlights, tail and stop lights, dash and parking lights, and horn. Use of light and horn relays. Use and selection of fuses. Sealed beam units. Horn tone adjustment.

Storage Battery - Voltage and hydrometer tests. Adding distilled water. Cleaning terminals. Replacement of cables and "ground" straps or terminals.

There are many opportunities in the foregoing practical work for various items of bench work, particularly soldering.

References: Same as for Automotives 1a.

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